

CLAIMS

1. A layered Fe-based alloy comprising a base material, which is composed of an Fe-based alloy, and a diffusion layer (20) which is formed by allowing a carbide to diffuse into said base material, the diffusion layer having a hardness higher than that of said base material, wherein:

a thickness of said diffusion layer (20), which is measured from a base point of a surface of said layered Fe-based alloy, is not less than 0.5 mm.

2. A layered Fe-based alloy, in which hardness is increased from a surface layer portion to an inside portion thereof, and comprising a diffusion layer (20) that exists on an outer surface of said surface layer portion, wherein:

said diffusion layer (20) contains a carbide formed by carbonizing a first element which has a property to increase hardness of an Fe-based alloy;

a second element other than said first element is contained in said Fe-based alloy, having an amount which is larger in said surface layer portion as compared with said inside portion thereof; and

an amount of said first element increases from said surface layer portion toward said inside portion.

3. A layered Fe-based alloy comprising a base

material composed of an Fe-based alloy and a diffusion layer (20) formed by allowing a carbide to diffuse into said base material, said diffusion layer having a hardness higher than that of said base material, wherein:

5 said hardness of said diffusion layer (20) decreases at deeper inside positions, and a thickness of said diffusion layer (20), which is measured from a base point of a surface of said base material, is not less than 0.5 mm; and

10 a concentration-varied portion, having a hardness that increases as an amount of an element having a property to increase said hardness of said base material increases from a surface layer portion to an inside portion of said base material, is provided in a part of the base material in which said diffusion layer (20) is absent.

15 4. The layered Fe-based alloy according to any one of claims 1 to 3, wherein said carbide is a carbide of Cr, W, Mo, V, Ni, or Mn.

20 5. The layered Fe-based alloy according to claim 4, wherein said carbide has a compositional formula of M_6C or $M_{23}C_6$ provided that M represents a metal element.

25 6. The layered Fe-based alloy according to any one of claims 1 to 3, wherein said carbide is obtained by carbonizing a solid solution of Fe and at least one of Cr, W, Mo, V, Ni, and Mn.

7. The layered Fe-based alloy according to claim 6,
wherein said carbide has a compositional formula of $(\text{Fe}, \text{M})_6\text{C}$ or $(\text{Fe}, \text{M})_{23}\text{C}_6$ provided that M represents a metal
5 element.

8. The layered Fe-based alloy according to claim 2,
wherein said second element is C, Si, Cu, Ti, Al, or Mg.

10 9. A method for producing a layered Fe-based alloy
comprising a base material composed of an Fe-based alloy and
a diffusion layer (20) formed by allowing a carbide to
diffuse into said base material, said diffusion layer having
a hardness higher than that of said base material, wherein a
15 thickness of said diffusion layer (20), measured from a base
point of a surface of said layered Fe-based alloy, is not
less than 0.5 mm, the method comprising the steps of:

applying, to a surface of said Fe-based alloy, a metal
powder to increase said hardness; and

20 heat-treating said Fe-based alloy with said metal
powder applied thereto, so that at least carbon contained in
said Fe-based alloy and said metal are reacted with each
other to form said carbide, wherein said carbide is diffused
into said Fe-based alloy.

25 10. The method for producing said layered Fe-based
alloy according to claim 9, wherein Cr, W, Mo, V, Ni, or Mn

is used as said metal.

11. A method for producing a layered Fe-based alloy having an increased hardness from a surface layer portion to an inside portion thereof, and further comprising a diffusion layer (20) existing on an outer surface of said surface layer portion, wherein said diffusion layer (20) contains a carbide formed by carbonizing a first element that has a property for increasing hardness of an Fe-based alloy, wherein a second element, other than said first element, is contained in said Fe-based alloy, said second element having an amount which is larger in said surface layer portion as compared with said inside portion, and wherein an amount of said first element increases from said surface layer portion to said inside portion, the method comprising the steps of:

applying, to a surface of said Fe-based alloy, a powder made up of a substance which contains said second element; and

heat-treating said Fe-based alloy with said powder applied thereto, so that said first element is diffused to said surface layer portion, and said first element reacts with carbon existing in said surface layer portion of said Fe-based alloy to form said carbide.

12. A method for producing a layered Fe-based alloy, comprising the steps of:

applying, to a surface of an Fe-based alloy, a powder made up of a substance containing a first element which increases hardness, while applying, to a part of the Fe-based alloy other than where said first element was applied, a powder made up of a substance containing a second element, wherein the second element is different from said first element and is contained in said Fe-based alloy, or applying, to said surface of said Fe-based alloy, said powder made up of said substance containing said second element, while applying said substance containing said first element to a part of the Fe-based alloy other than where said second element was applied;

applying heat treatment to said Fe-based alloy after applying said powders thereto, each powder containing said first element or said second element respectively, so that a diffusion layer (20), having a thickness of not less than 0.5 mm and a hardness higher than that of a base material, is provided at said part to which said powder of said substance containing said first element was applied, while a concentration-varied portion, in which a hardness thereof is increased as an amount of an element having a property to increase said hardness of said base material is increased from a surface layer portion to an inside portion of said base material, is provided at said part to which said powder of said substance containing said second element was applied,

wherein said diffusion layer (20) is provided such that

said first element is diffused into said Fe-based alloy, thereby diffusing said carbide into the Fe-based alloy by causing a reaction with carbon of said Fe-based alloy, and

5 wherein said concentration-varied portion is provided such that said first element of said Fe-based alloy is diffused from said inside portion to said surface layer portion of said Fe-based alloy, and carbon, which exists in said surface layer portion, reacts with said first element to form a carbide-containing coating, thereby discharging
10 said first element from said base material.

13. The method for producing said layered Fe-based alloy according to claim 11 or 12, wherein Cr, W, Mo, V, Ni, or Mn is used as said first element.

15 14. The method for producing said layered Fe-based alloy according to any one of claims 11 to 13, wherein C, Si, Cu, Ti, Al, or Mg is used as said second element.

20 15. The method for producing said layered Fe-based alloy according to claim 10, further comprising a step of removing said coating.